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AUTHOR: Mindin, O. A.

TITLE: Theory of motion of bodies of variable mass in relativistic version

PERIODICAL: Akademiya nauk Ukrayins'koyi RSR. Instyut mekhaniky. Prikladna mekhanika, v. 8, no. 5, 1962, 546-551

TEXT: The author considers the motion in the absence of external forces, assuming that the fuel mass dm used during a time dt is split into two parts, which he calles defect mass dm_d and slag mass $d\mu$. One part of dm_d is converted into electromagnetic radiation and the other is used for disposing of $d\mu$. Velocities close to the velocity of light are considered. The basic equations of motion are taken from a paper by V. F. Kotov.* Using the relativistic formula of addition of velocities, the author obtains the differential equation of the problem, whose solution is

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Theory of motion ...

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$$\frac{M_e}{M_{eo}} = \beta \sqrt{\left[\frac{F(v)}{F(0)}\right]^{\delta} \frac{f(0)}{f(v)}} \qquad (1.7)$$

where M_e denotes the rest mass of the body, $\beta = v/c$.

$$\Delta = -\left\{4u_r c^2 [\alpha\varepsilon c + (1-\varepsilon)u_r] + \varepsilon^2 c^2 (\alpha u_r - c)^2\right\}$$

$$u_r v^2 + (\alpha u_r - c)\varepsilon c v - c^2 [\alpha\varepsilon c + (1-\varepsilon)u_r] = f(v)$$

* V. F. Kotov, Theory of New Rocket Types, Odessa Govt. Inst. im. I. I. Mechnikov, Math Science Series, 146, 6, 1956.

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$$\frac{2u_r v + \varepsilon c(\alpha u_r - c) - \sqrt{-\Delta}}{2u_r v + \varepsilon c(\alpha u_r - c) + \sqrt{-\Delta}} = F(v); \quad \frac{c[(2 - \varepsilon)c + \varepsilon\alpha u_r]}{\sqrt{-\Delta}} = \delta$$

u_r is the relative velocity with which the slag mass is ejected, α is the radiation coefficient and ε the mass defect coefficient, the initial values are

$$M_e = M_{eo}; \ v = 0; \ f(v) = f(0); \ F(v) = F(0)$$

An implicit formula is obtained for the final velocity of the body, when the fuel has been consumed. For u_r

$$u_r = c\left\{1 - \left[\frac{1 - \varepsilon}{\varepsilon(1 - \alpha) + (1 - \varepsilon)}\right]^2\right\}^{\frac{1}{2}} \tag{2.2}$$

is derived. When $\alpha = \varepsilon = 1$, $u_r = 0$, a differential equation is obtained which was solved by Kotov. When v^2/c^2 is small, another result of Kotov is obtained.

ASSOCIATION: Odes'kyy derzhavnyy universytet (Odessa State University)

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